

The "M.E." Speed Boat Competition

THE MODEL ENGINEER

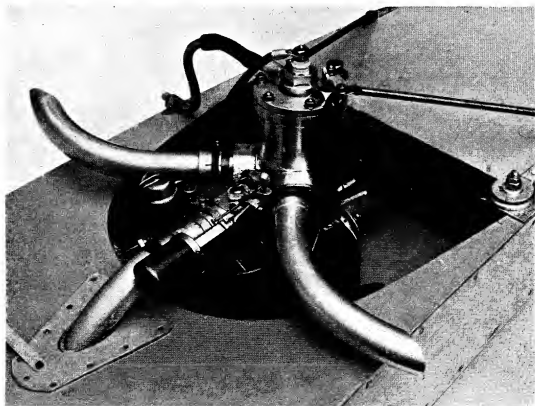
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A REMARKABLE MODEL SPEED BOAT ENGINE

This engine, which will be recognised by many model speed boat enthusiasts, is the 30 c.c. two-stroke installed in Mr. A. D. Rankine's *Oigh Alba*, which is one of the few boats in the world to have attained a speed of well over 40 m.p.h. and features in the 1939 "M.E." Speed Boat Competition, fully reviewed in this issue.



THE MODEL ENGINEER

Vol. 82 No. 2021

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February 1st, 1940

Smoke Rings

Hold Fast to the "M.E."

IT was, perhaps, only natural that during the early months of the war, when so many of our followers were suddenly called up for military or other national service, there should be a temporary break in the continuity of their readership of the "M.E." Our circulation has, however, steadied itself, and is once again on the upward grade. I could advance many reasons why the "M.E." should still be purchased by old-time readers, even if their workshops are temporarily out of commission, and spare time for reading may be scarce, but one "old faithful" has anticipated anything I might wish to say, and has sent me the following admirably reasoned argument for being once a reader always a reader. This comes from Mr. C. B. Carlyle, of Burnham-on-Sea, and I would thank him for putting the case so sympathetically and so well. He writes:—"In these difficult days probably many of your readers will have found themselves unable to carry on their model work for one reason and another, and may feel that it is not worth while to take THE MODEL ENGINEER until the return of happier times. Now, it is on this latter point that I wished to rally the members of the greatest of all hobbies, and to urge them, before giving up their old friend, to consider carefully the ultimate wisdom of such a course. If very many of its readers cancel their weekly copy the circulation of the paper must necessarily fall, and no paper, however enthusiastically its staff may strive to carry on, can indefinitely survive this condition, coupled with the rise in cost of production. If anything should happen to THE MODEL ENGINEER, gone is the mainspring of model engineering; the mainspring which has fostered the art and science for over 40 years, and which has made possible for them the production of those models of which we are justly proud, and which is the meeting place for all our enthusiasms, ideas and club activities. It may not have occurred to the average reader that if it had not been for the pioneer work of the 'M.E.', we should not have had the supply of modern tools and equipment made available for the model engineer. Have we not always felt that the 'M.E.' is not merely a weekly paper to be read and thrown aside, but that it has a very distinct personality; it breathes a friendly spirit and is our mentor and sympathetic friend when we are in trouble, as the correspon-

dence columns show? We all have those stacks of copies to which we proudly point and know that in those dusty piles stretching through the past years is the concentrated knowledge of many sages all dedicated to our work. I would say to all readers, take your weekly 'M.E.' even if you cannot read it now, and think what a glorious time you will have reading all those unopened copies which will await your return. If I have let my pen run away in the cause, and have appealed for the loyalty of readers with undue enthusiasm, I hope to be forgiven, but looking fondly at my 25 years' collection of 'M.E.'s I am unrepentant." I would only add to this that there is no fear of anything untoward happening to the "M.E." We shall have our difficulties, of course, especially in regard to paper cost and supplies, and other costs of production, but we survived one great war, and so long as we have good friends who think as Mr. Carlyle does, we shall survive another. The loyalty and enthusiasm of our staff and contributors remains as high as ever. Here is a practical suggestion: if your relative or your friend has joined up, and is "Somewhere in England," or in France or at sea, buy the "M.E." and mail it to him. He will be very grateful, and it will warm his heart to feel that he is still one of the great brotherhood of model engineers, and still in touch with, as Mr. Carlyle puts it, the "greatest of all hobbies."

* * *

Jobs in the West Country

A CORRESPONDENT whose inspection duties bring him into contact with many firms on Government work in the West Country, writes me that there is a great dearth of skilled mechanics and machinists. In particular, he mentions a vacancy for a charge-hand and setter-up for a battery of capstan lathes and milling machines. If any qualified readers who are interested in obtaining work in what is regarded as a "safety zone" will write to me, I will forward their applications to my correspondent, and he will see if arrangements can be made to place them. Letters should be addressed to "West Country," c/o Editor of the "M.E."

Percival Marshall

The "Model Engineer" Speed Boat Competition, 1939

THE decision to hold the "M.E." Speed Boat

Competition as usual last year was made after very careful consideration, and under no misapprehensions as to the difficulties which would be encountered by competitors in carrying on under war conditions. It is, therefore, particularly gratifying to note that, while these difficulties have undoubtedly prevented several intending

timed runs have been obtained for the 1939 event, and that both of them are of outstanding merit. Another feature of interest in this respect is that the run of *Rednip IV* was timed by means of the electrically-recorded chronograph constructed by Mr. P. Ivison, of the Malden Club, and described in the "M.E." last year, the actual record strip, with the signatures of timekeepers and observers, being submitted with the entry form to support the authenticity of the claim. This method of timing is one which we wish to encourage, not only because it represents a great improvement, in accuracy and reliability, over hand methods of timing, but also because it offers an admirable example of two totally different branches of experimental research co-operating to mutual advantage, and proves that there is scope for the highest skill and intelligence in model-power boat racing.

The Chesterfield Club, which was represented for the first time in the 1938 competition by Mr. A. Hutton, who put up an excellent performance in "C" class with his unconventional boat *Roberti*, claims still higher honours in this competition. Mr. J. P. Orme's new "C" class boat, *Skua*, has attained a speed of over 40 m.p.h., a truly remarkable performance for a boat powered with



Mr. A. W. Cockman, assisted by Mr. E. Clarke, starting up *Ifit VI*.

entrants from putting in an eligible run, and have also caused the technical disqualification of the worthy effort of one entrant, the competition has been quite as well supported as in some of the pre-war years. Altogether, eleven entries were received, but as two of these refer to one boat, and one does not comply strictly with the rules, the actual number of qualifying entries is nine.

The London clubs are represented by the irrepressible *Ifit VI*, of the Victoria Club, and *Rednip IV*, of the South London and Malden Clubs. It may be remembered that both these boats were deprived of their due recognition in the 1938 competition through timing difficulties, and we are, therefore, very glad to see that properly



A photograph of Mr. K. Williams with his boat *Faro*, taken at the 1939 Farnborough M.P.B.A. Regatta.



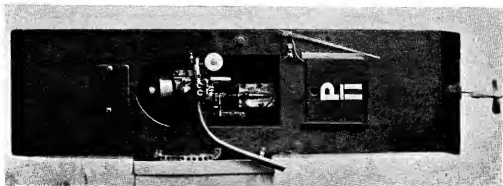
Mr. P. Bailey's *Dyna III*, one of the "A" class entries from the Portsmouth Model Steamboat Club.

a 15 c.c. engine, and the highest speed so far recorded in this class.

The other two entries in "C" class are from the Altrincham Club, which is noted for its successful activities in this class during recent years. No less than three entries in "A" class are submitted from the Portsmouth Club, and we wish especially to commend the enterprise of this club for their wholehearted support of the competition. It is true that no very outstanding feats of performance are shown by the boats in question,

encouraging other competitors who are also, as yet, some distance from the top of the ladder.

Last, but not least, we welcome the entry of Mr. A. D. Rankine's *Oigh Alba*, which, after a temporary eclipse, has made a very successful come-back, entirely justifying his determined exploitation of original and unorthodox ideas in hull design. Incidentally, we note that, although more than one boat of this name has been built, the present example bears no serial number, and this raises a very important question in respect

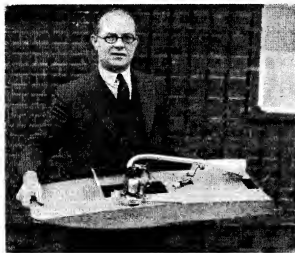


Two views of Mr. A. E. Jubber's *Venesta II*.

but this is not the point which matters; the competitor who submits an entry which, he knows, can hardly qualify for a major award, is not only furthering one of the most important aims of the competition, that of providing statistical data of average performance and general progress, but is

of the proper identification of boats. A great deal of confusion has often arisen as to "which boat was which" in compiling historical records of past performances, and the situation is rendered even more chaotic if serial numbers are omitted. There are, undoubtedly, many difficulties in the proper

and systematic naming of model speed boats, as few of them have an immutable identity throughout their career, what with repairs, reconstructions, and improvements; some of them might even be compared with the traditional umbrella, which had been once re-handled, twice re-framed, three times re-covered, and had once been changed for a better one in a restaurant! Nevertheless, we think that some definite ruling on this matter might be made, and we suggest that, in any case, where a power plant is transferred to a completely new hull, or a hull is fitted with a completely new power plant, the name or serial number should be changed. This, we believe, has been the case with the famous *Ifit* dynasty, in which at least three of the boats, bearing distinctive serial numbers, have carried the same power plant, though the latter has been re-fitted, re-bored, re-boilered, etc., times without number.



Mr. L. S. Pinder with *Rednip IV* ("B" Class), which put up the best speed performance in the competition.

In respect of Mr. Williams' "A" class boat, *Faro*, it is very much to be regretted that this boat failed to qualify, owing to the fact that the distance specified by the rules for this class was not fully completed. There is no doubt whatever about the authenticity of the speed claimed, as the run was made at a public regatta, and we are, therefore, awarding a certificate to this boat, in recognition of a very fine effort.

If the results of this competition may be taken as more or less representative of general tendencies, evidence is once again forthcoming of the advantages to be obtained by keeping down weight, as the average standard of performance is definitely in favour of the lighter boats. So far as maximum speeds are concerned, the "B" class again beats the "A" class by a very small margin, while the "C" class has approached yet closer to the speed attained by the larger-engined boats—still further evidence of the importance of power/weight ratio.

Hull Design

There is practically nothing to report regarding the development of hull design, as practically all the boats exhibit familiar and well-tried features of design, with the exception of *Oigh Alba*, the unusual design of which has been discussed several times in the past. The severely simple "scow" type of hull is still with us, but shows signs of declining in popularity, despite the fact that constructional simplicity appears to be just as much sought after as ever. In the majority of cases, hulls slightly swept in at the bow, and tapered off at the after end, so that the maximum beam is at or near the step, are favoured. This principle, which was discussed in our review of the 1938 competition, tends to improve fore-and-aft stability by locating the most powerful lifting effect as near as possible to the centre of gravity, and thus minimising the tendency for the trim to become upset, either in rough water or under varying propulsive effect.

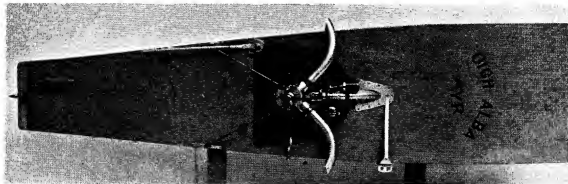
All the hulls, with the exception of *Oigh Alba*, are of the single-step type, with the step situated approximately amidships. The one exception mentioned has a second step, formed by the addition of two false planes on the underside of the hull, forward of the main step. It is possible that these constitute an experimental feature, and that they have been added to the hull since it was first built, with a view to checking tendencies to violent changes of trim at high speed, for which this boat's predecessors have been noted. Criticism of Mr. Rankine's hulls, however, which has been very freely indulged in at various times, should be tempered by the consideration that many problems arise in stabilising such a light boat, which would be entirely absent, or much reduced, in a boat having much greater natural inertia.

Planing angles are generally moderate, so far as can be ascertained from careful examination of the photographs submitted with the entry forms.

Engine Design

Here, again, there is very little to report, as apart from individually-designed engines which have, in most cases, been described or referred to in past issues of the "M.E.," the others have either been made entirely from commercial castings or based upon well-known designs. It would appear that there are few of such designs which can be ruled out as incapable of being successfully applied to racing, though some designs lack the stamina which is necessary for consistent high performance, and in addition to the tuning which is invariably necessary to attain such results, would call for a good deal of detail improvement and stiffening-up to enable their tune to be maintained.

So far as individually-designed engines are concerned, the engine of Mr. Pinder's *Rednip IV*, which achieved the highest speed in this competition, is, we believe, the identical one which was installed in the first boat of this series, and has



Plan view of Mr. A. D. Rankine's *Oigh Alba*.

been fully described in the "M.E." It has an aluminium-bronze cylinder head, machined from the solid, with vertical valves, and is also fitted with twin camshafts, spur-gearred to the crankshaft, and operating the valves through swinging followers, push-rods and overhead rockers. Mr. Williams' *Faro* has an engine with inclined valves, operated through tappets, push-rods and offset rockers, from a side camshaft; this engine has also been described in the "M.E."

Mr. Orme's boat has an engine fitted with internal flywheels, and the main bearings are ball-races $\frac{1}{2}$ " journal dia., with a plain phosphor-bronze big-end. The cylinder head is of cast-iron, with inclined valves having hairpin valve-springs, and operated by push-rods and roller tappets from a camshaft running in $\frac{1}{2}$ " ball-races.

The most original and unusual example of engine design is *Oigh Alba*'s two-stroke, which has been the centre of interest at every regatta at which it has appeared. Few engines which have ever been installed in model speed boats have been more ingenious in conception or perfect in execution; while it is, in principle, nothing more or less than an ordinary "valveless" two-stroke engine, it bristles with little details that are "different," and collectively, no doubt, make all the difference to its efficiency. It is equipped with a float-feed carburettor having a fixed submerged jet and an annular diffuser, and yet another distinctive

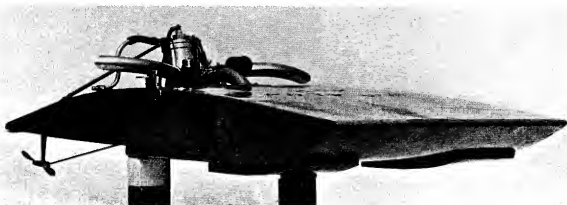
feature is the flywheel magneto, which is built into the engine, and undoubtedly is a very important factor in its reliability and success.

With this one exception, battery and coil ignition is universally employed on the engines of the boats entered in this competition; all the coils are of the non-trembler type, and the batteries appear to be, in all cases, accumulators of the free acid or glass-wool filled type. All carburettors are float-fed, and generally follow motor-cycle principles. Delay-action gear operating on either the carburettor or the ignition is almost universally fitted.

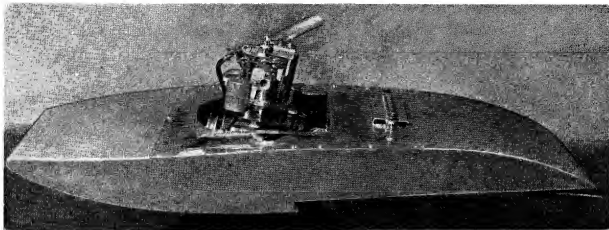
The one example of flash steam plant featured in this competition is so well known as to call for very little comment. It comprises a double-coil boiler of more or less conventional type, fired by a twin-burner blowlamp, and an enclosed twin-cylinder single-acting engine having separate piston-valves for steam and exhaust, arranged horizontally over the cylinders.

Propellers and Transmission

A close agreement may be observed in the diameter, pitch and blade area of propellers, for boats in a given class, though there are one or two notable exceptions, as in the "C" class entries, where one boat has a propeller having twice the pitch of that on the other boat from the same club. It is, in such circumstances, quite obvious that



This view of *Oigh Alba* clearly shows the two false planes attached to the underside of the fore plane, constituting an extra "step."



Mr. J. P. Orme's *Skua*, which achieved the highest speed ever attained by a "C" class boat in this competition.

there must be a very considerable difference in the r.p.m. of the engines of these two boats, but although it would be easy to form conclusions as to which engine is working at its most efficient speed, it is by no means certain that the other boat would immediately benefit by conforming to the same propeller specification. Generalisations, in model speed boat design, are nearly always fatal; but when there is a tendency towards agreement in salient features such as this, it may usually be taken to indicate that development is along the right lines.

So far as can be gathered from the photographs, all boats employ articulated propeller shafts, and, in most cases, the propeller is situated aft of the

stern bracket, though in *Rednip IV* and *Satellite III*, it is situated forward of the latter, immediately behind the transmission shaft universal joint. The pros and cons of the respective arrangements have been very widely debated, but there is as yet very little real evidence as to which is the more efficient. All the propellers are, as usual, two-bladed.

Personal Notes

All the competitors are members of model power boat clubs, and, with the exception of Messrs. Lane and Jubber, of Portsmouth, and Mr. J. P. Orme, have taken part in the competition in previous years. The two former competitors appear to be newcomers to model power boat racing, and their boats are comparatively new, or at any rate, have not featured in inter-club regattas prior to 1939. The remaining Portsmouth competitor, Mr. P. Bailey, made his debut in the 1938 competition with the predecessor of his present boat.

Mr. J. P. Orme is one of the original members of the Chesterfield Club, and although he has not previously been distinguished by any marked successes in model power boat racing, he has been a keen experimenter and a very persistent trier for several years. His early adventures with model speed boats were described in the issue of the "M.E." dated November 14th, 1935.

Among the other names on this list, that of Mr. A. W. Cockman deserves recognition, if for no other reason than for his patience in the face of innumerable mishaps and setbacks; his family motto must surely be "Nil Desperandum." The name which he has applied to his boats, and which has become a password in the model power boat world, does not betoken any undue or exuberant optimism about its merits; but we might suggest an even better one—*Tantalus*; for never has anyone had the cup of success snatched more rudely or more frequently from his lips than Mr. Cockman himself.

Mr. Cockman submitted two entries for the competition, the first of which was in respect of a



Mr. D. Innes, with *Satellite III*, at Farnborough Regatta.

NAME OF BOAT	OWNER	TOTAL WEIGHT LBS	ENGINE				HULL			PROPELLER			SPEED M P H
			No OF CYLINDERS	TYPE	BORE	STROKE	LENGTH INS.	MAX BEAM INS.	No OF STEPS	DIA. INS.	PITCH INS.	BLADE AREA, SQ.	
CLASS "A" (BOATS OVER 12 LBS)													
IFIT VI	AWCOCKMAN	15½	2	5 A STEAM	0 77 in	7/8 in	38	11½	1	3¾	6 ½	2' 1	44'38
REX	C A LANE	14½	1	4-STROKE	1 1/8 in	1 1/8 in	41	10	1	3¾	6 ½	2 1/8	30'58
VENESTA II	A E JUBBER	13	1	4-STROKE	1 1/8 in	1 1/8 in	39 37	11½	1	3¾	8	2 1/4	29'71
DYNA III	P BAILEY	14	1	4-STROKE	36 mm	29 mm	38	12	1	3½	6½	2 1/4	28'6
CLASS "B" (STEAM BOATS 7 TO 12 LBS. & I C BOATS 8½ TO 12 LBS)													
REDNIP IV	L S PINDER	11'59	1	4-STROKE	1 1/8 in.	1 1/8 in	38	11½	1	3¾	6¾	0'96	45'94
OIGH ALBA	A D RANKINE	8½	1	2-STROKE	1 35 in	1 25 in	46	12	2	3	5¾	1'4	43'6
CLASS "C" (STEAM BOATS UNDER 7 LBS & I C BOATS UNDER 8½ LBS)													
SKUA	J PORME	7½	1	4-STROKE	1 in	1 1/8 in	30	10½	1	2½	4	1	40'78
SATELLITE III	D INNES	6½	1	4-STROKE	1 in.	1 1/8 in	33½	10	1	2½	3	1¼	38'26
MRS. FREQUENTLY II	H WRAITH	7¾	1	4-STROKE	1 in	1 1/8	33	10	1	2½	6	NOT STATED	27'8

Results of the 1939 "M.E." Speed Boat Competition.

run made early last September. This was quite a good effort, and would have been even better, but for the fact that one of the pistons seized on the fourth lap, tearing away a large portion of the skirt and gudgeon-pin bosses, the pieces jamming between the crank-webs and connecting-rod, resulting in the latter being almost literally "tied in a knot." In spite of this, however, the boat did not stop, but finished the rest of the run at reduced speed, the average for the six laps being 42.84 m.p.h. After the engine had been completely re-built, it was found possible to make another run, just in time to qualify for the competition, with an improvement in speed as shown in the above table of results.

The model power boat racing career of Mr. L. S. Pinder has been almost as thorny as that of *Ifit's* owner, and during the 1938 season he had no less than three boats wrecked, in addition to which he had the bitter disappointment of losing recognition of a world record through a default in timekeeping. The run entered for this year's competition, although heading the list, has failed to recapture the speed achieved on that occasion. Mr. Williams, who was unable to complete a run of sufficient length to qualify for an award in this competition, owing to the closing of his club's pond at the outbreak of war, has also seen much of the seamy side of the sport. On one occasion, his boat capsized and took a charge of water into the engine, which caused the cylinder head to part company with the barrel on the compression stroke. Similar experiences have befallen Mr. Innes and also Mr. Rankine, both of whose boats have set up their own styles in hydrobatics, and who have more than once left the pond with their hulls or their engines, or both, in small pieces. These incidents, however, are all in the day's work, and those who fail to pass this severe test of

patience and determination can rarely attain lasting success with model speed boats. To many readers, the rewards of such enterprise may appear entirely inadequate, and this is perfectly true if the only rewards considered are the material ones; but to the true enthusiast, the surmounting of apparently insurmountable obstacles and difficulties, and the joy of achievement, are the real rewards, for which the most strenuous efforts are deemed well worth while.

For the Bookshelf

Aircraft Identification. (London: The Temple Press, Ltd.) Price 1s. 3d. net.

The second edition of this useful little book is available. It is of particular interest just now, as it contains illustrations in half-tone and silhouette of British, French and enemy aircraft, with descriptive notes to enable ready identification to be made. The contents have been revised, where necessary, and enlarged to include particulars of the latest types of aircraft engaged in present hostilities.

Railways. (Published at 55, Watford Road, Radlett, Herts.) Price 1s. 3d. bi-monthly.

A new periodical devoted exclusively to the subject indicated by its title. We have perused a copy of its first issue, which is well produced and profusely illustrated; in fact, the excellent photographic reproductions, the majority of which are of large size, seem to be the main feature of this bright new journal. The bi-monthly publication dates have been adopted temporarily for the duration of the war. There is a "Model" section edited by Edward Beal.

'The History of "Tich Too"'

An account, based upon records in the log book of the development of a miniature flash-steam hydroplane

By H. J. Turpin

THE water pick-up and filter combined consists of four main pieces—A a cap, B the base, C the pick-up tube, having two $\frac{1}{8}$ " dia. holes facing direction of motion, and a gauge filter D.

The pick-up tube has a spigot $\frac{5}{8}$ " dia.; this spigot fits into a hole in the front plane and is fixed by three screws passing through the base B from inside the boat. Shellac varnish in the joints makes the spigot leak-proof. As the flange of the spigot is only 0.02" thick at the edge, the obstruction to flow on the front plane is practically negligible.

Water is taken off by rubber tube fixed to cap A. This device is very easy to make and fix, and the cap can be readily unscrewed for cleaning. It was only discarded because it was suspected of taking in air instead of water when the boat bounced a little. I was sorry to part with this pick-up because it is one of those gadgets which, if I were about forty years younger, would find a place among other things under my pillow at night.

* Continued from page 55, "M.E.," January 18, 1940.

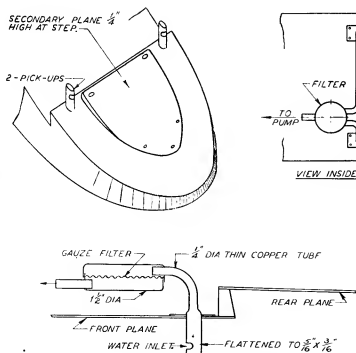
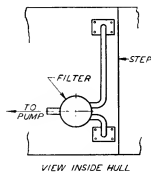


Fig. 4. Secondary plane and dual pick-ups.



At this particular period of running, the boat did not rise satisfactorily on the front plane, and I was advised to fit a false plane. This was done for the following Sunday, the device being illustrated in Fig. 4.

Tich Too then made a frantic effort to emulate Tom Mix on horseback, to the amusement of a small family crowd, and it is impossible to record all her actions in words.

The fitting of the false plane precluded, in any case, the use of the pick-up in Fig. 3, so I was more or less compelled to fit one on each side and feed water into a common reservoir. Fig. 4 shows the idea.

The False Plane

The false plane is made from aluminium, 24 gauge and $\frac{1}{4}$ in. high at the step, gradually merging tangentially into the front plane about 8 in. forward. Water pick-up system is made from thin walled copper tube $\frac{1}{4}$ in. dia. flattened under the front plane to a depth of one inch to decrease resistance to motion, and the two bottom ends are closed by soldering in little oval discs. A nick,

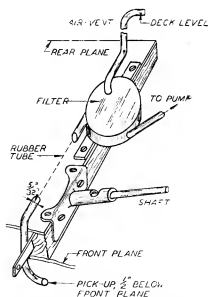


Fig. 5. Change over to brass tube pick-up.

about $\frac{1}{2}$ in. high, made by a small round file, is made across the front of each oval tube to admit water, and there is no doubt that that part of the device is successful.

The effect of these two depending tubes on the boat at speed is really laughable. The propeller urges the boat on to the front plane and only succeeds when the pick-ups are travelling in the cavity between two waves. The boat then rises rapidly, owing to the increased steepness of the angle of the false plane, and then comes down with a plop to submerge the pick-ups again. And so the antics continue for one or two laps at a speed of about 10 m.p.h. Needless to say, another device was fitted for the following Sunday.

A Simpler Pick-up

Fig. 5 comes next. False plane was removed and a simpler pick-up fitted. This time it was a piece of $\frac{5}{32}$ " dia. brass tube fixed to the rear face of the step and, passing through the floor of the hull, was connected to the reservoir by a piece of rubber tube. Water was admitted to the top of the reservoir and, passing down through a gauze disc about $1\frac{1}{2}$ " dia., was drawn off by a $\frac{5}{32}$ " dia. tube facing the water-pump suction pipe.

A feature of this pick-up is the introduction of an air vent and overflow pipe mainly for the

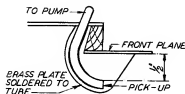


Fig. 6. Deflector for fouling added to Fig. 5.

purpose of discovering if the reservoir is ever really full. This justified its existence in emitting a jet of water, full bore, all the time the boat travelled at a fair speed. It was found, however, that in order to prime the boiler with the hand pump it was necessary to close the vent (with a match, usually) after all air had been excluded from the filter.

If it were possible to run flash-steam hydroplanes in clean unadulterated water, then this pick-up would have been an unqualified success. However, on July 24th, when the next run was made, the flotsam was the worst I have ever seen and, judging from the subsequent behaviour of the boat, I should say it was absorbed by the pump.

The Remedy

Fig. 6 illustrates the remedy against this trouble. It is a guard in the form of a brass plate 28 gauge soldered to one side of the tube and of the profile shown in the sketch. This guard is fixed on the side remote from the centre of rotation, and is tangential to the circle on which the boat is running. This arrangement guides the water

into the tube. If placed on the inside of pick-up tube then a partial vacuum would be formed at the tube entrance. This feature—Fig. 6—was retained for the remainder of the season, but the reservoir and pipe arrangement underwent further modification.

Continually being troubled by irregular running, I still suspected the behaviour of the water on the

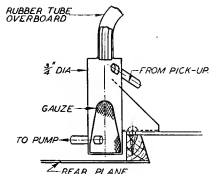


Fig. 7. Vertical type reservoir—the first fitted.

suction side of the pump and decided that, in the flat type of reservoir, the water might be in a greatly agitated condition and causing the pump to mis-feed, so another shape was installed. This is shown in Fig. 7—tall and narrow to reduce turbulence, and with a thimble-shaped gauze in the bottom. This, however, made no improvement in the running, so I cut off the top half and added a portion of larger diameter to allow greater reserve of water to be held, yet still restricting the turbulence at the bottom. This last arrangement is shown in Fig. 8. Still there was no improvement in the running.

The foregoing is a summary of the variations made in the intake arrangements. In retrospect,

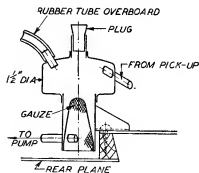


Fig. 8. Enlarged container added to Fig. 7.

however, they were not the real cause of the trouble so, apart from the dual pick-up shown in Fig. 4, all the others would have functioned with some degree of success if other conditions had been favourable.

(To be continued)

* Gauges and Gauging

A series of great value to engineers of all classes, particularly those who are engaged upon national service

By R. Barnard Way

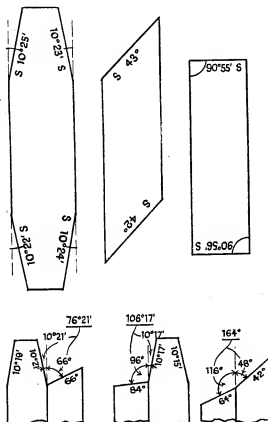
THERE are still a few notes to add on the subject of the gauging of angles, to carry on from our last article. There is a set of angle gauges made by Johanssen that is not very often met with, but they can be very useful in some ways. Like all the products of this company their finish and accuracy is beyond reproach. The only criticism the author has to offer is that the bevelled

that the angle is made with the long straight side. In similar fashion, there are plates covering the degree between 90° and 91° , also by one minute increases, but on these plates there are only two angles to each. The outfit is completed with a set of whole degree angles from 11° to 90° , rising by single degrees. Used separately, the range of angles is limited, but by combining the plates in pairs a complete range from 10° to 350° , rising by one minute steps can be made up. We show one or two examples of these.

It is not often in regular engineering that angles more precise than those to the nearest minute are required, but when this is the case an instrument of extreme precision will be necessary. The principle of the spirit level is employed here, and though there are several machines to be found, the author has only handled one, the Clinometer of the Société Genevoise, a beautifully made device that will give positive indications to $1/10$ th of a minute, that is, 6 seconds of arc.

A sectional view of the machine is given here, somewhat simplified for the sake of greater clearness. The spirit bubble tube is mounted on a pivoted frame that can be rocked up or down by means of a fine thread worm and toothed arc. The head of the worm spindle is graduated into 180 divisions, and one complete turn represents a movement of the rocking frame through one half of a degree. Consequently, one division on the head represents an angle of $10''$. All that is necessary is to turn the head until the required angle has been recorded, and then tilt the whole machine until the bubble is central in its tube. The angle of tilt is the angle required.

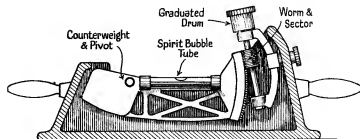
The tube is graduated in steps equivalent to $6''$ of arc, which gives an additional degree of accuracy. The machine will only handle angles up to 30° . In order to eliminate all backlash in the worm and arc teeth, a spring keeps them in proper engagement, and a counterweight balances the rocking frame.



Johanssen Angle Gauges.

surfaces are not sufficiently long to permit the exact adjustment of tools or other devices.

The set of angle gauges consists of 85 flat narrow plates of hardened steel. The first range covers 10° to 11° with increases of one minute, and there are four angles to each plate. Our sketch shows the form of these plates, from which it can be seen

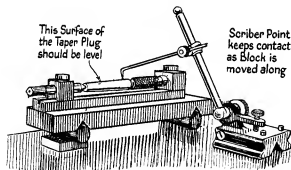


Diagrammatic arrangement of the Société Genevoise clinometer.

* Continued from page 72, "M.E.," January 18, 1940.

Before we leave this subject of the gauging of angles, we think it would be of interest to show just one adaptation of the sine bar, in this case to test the truth of a taper plug gauge. On a sine surface block is laid a centring block, carrying the taper plug between its centres. The sine block has been tilted to the angle of the taper, which means that the top surface of the plug should be truly horizontal. To try this out, an indicator in the form of a scribing block is used, the bent end of the scriber being nicely adjusted to touch one end of the top surface. If the plug gauge is finished to the correct angle, then the scriber point should keep contact with the surface as the block is moved along. Rotating the taper plug should keep the contact.

Later on, we will show how an indicating gauge can be employed to show the extent of the inaccuracy, if any. Such a test as the simple one just mentioned depends on the keenness of sight



Testing a taper plug gauge by sine block and surface gauge.

of the operator to a great extent, and so is not as reliable as one that provides a physical contact with a definite indication that contact is being maintained constantly. This can be done in a variety of ways, but as they involve the use of devices we have not yet examined, we had better leave their discussion until later.

There remain a number of workshop tools to enumerate, all of which are essential in the tool-room, though many of them are familiar enough to any accurate worker. The surface gauge, or scribing block, is well known, of course, and hardly requires much introduction. They will all be of the precision variety, in which the scriber carrier can be rocked on its pivot by a fine-threaded screw, thus providing a very nice degree of adjustment of the points. The base will have a V-groove running the whole length so that, if required, it can be used on a cylindrical surface, and there will be two pins at the rear end that can be pushed down to serve the purpose of guides. In this way, the gauge can be guided by the straight edge of the surface block, or any truly cut slot in the surface on which the tool is being worked.

There are no tools that can conveniently replace the surface gauge when it comes to accurate

setting-out; it is simple to learn, and its adaptations numerous; what is more, a good one is not unduly expensive. Good work can be done with the simplest possible type, but the fully adjustable sort is well worth the extra cost.

The range of calipers will be considerable, both as to type and size. Though we must look at them with a little detail, we shall not have room here to go fully into the subject, for there is material for a whole book about them. We cannot omit some details, in a series dealing with accurate measurement, of the tools by which those measurements are made and checked, believing that there may be many readers still unfamiliar with the principles.

There are, in a general way, three sorts of calipers, ranging from the simple "hit or miss" type, through to the carefully adjusted sort with screw settings; then the registering variety that need no graduated rule for their setting, and finally the micrometer gauges.

The simple caliper, inside or outside, is well known of course; it is a valuable aid to the workman, but it has to be used with care, or else it can only be regarded as a "rough" tool. Indeed, that is all that it can be reckoned when the making of limit gauges is the job in hand. However, there are others that are very useful indeed, designed for a variety of measuring and scribing operations, one leg being provided with a scriber point and the other formed to engage with a cylindrical surface, or in a T-slot, or, again, with the true edge of the job in hand. The transfer caliper is useful for taking measurements from the inside of spherical apertures that would otherwise prevent the withdrawal of the points. A detail of this tool is shown here, from which it can be seen that there are, in effect, three legs to the tool, two of which can be locked firmly together by a taper bush. These two are the short, false leg, and one of the true legs; the other true leg is free to move in or out to make the measurements required. Normally, the locking nut is eased off and the free leg is locked to the false leg by a nut and screw, so that as the free leg is moved the false one moves with it. When the measurement has been made, the locking nut is screwed home, and the nut clamping the free and false legs eased off. This allows the free leg to be moved to clear the work, so as to make withdrawal easy, but it can immediately be pushed back into exact position again relative to the false leg and the measurement recorded.

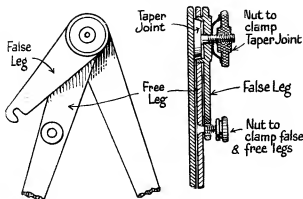
With the addition of a screw adjustment, this tool can be one of the most valuable additions to the toolmaker's kit, so we have found it, and make no apology for thus dealing with it at length.

The old-fashioned self-registering caliper is not much seen to-day, it had a useful vogue some years ago. A graduated scale on the head recorded the leg opening, but not to any greater degree of accuracy than $1/16"$, or at most $1/32"$.

Spring type calipers are generally regarded as the best for accurate work, as they must have

screw adjustment, a real necessity for fine settings. A quick adjustment can be had in the form of a spring nut that will slide along the screw when the spring pressure is released momentarily. These calipers are made for both inside and outside measuring, with a variety of points.

The third type of caliper, the micrometer, is an extensive family indeed, and it is hard to say



A detail of the transfer caliper.

where the dividing line appears between the pocket micrometer and the lordly measuring machines capable of splitting the one-hundred thousandth part of an inch.

There are first the sliding calipers, or slide gauges, whichever you prefer. These are simple tools, with a sliding jaw running on a long graduated extension of a fixed jaw. The graduations indicate the opening between the jaws, but as most of these gauges are designed to take both inside and outside measurements, two index marks have to be provided for reading purposes.

For accurate readings, the Vernier scale has been added to the improved type of slide gauge known as Caliper Square. In addition, a fine screw adjustment is also provided. As with the angle vernier, we think it just as well to put in a simple instruction or two on the reading of this type. There is nothing difficult about it, and the principle is just exactly the same.

Verniers can be made to read fractions of an inch, fractions of the old sort, but the rule now is to use decimals, though in some shops the fractions are freely combined with decimals to indicate manufacturing limits. Quite a moderate-priced slide gauge will read to the one thousandth of one inch.

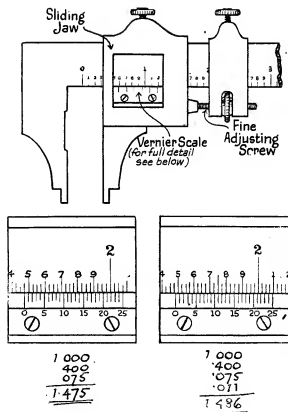
The fixed scale is graduated in inches, subdivided into tenths, and then fortieths. Each small subdivision is thus equal to $0.025''$. The moving scale or vernier extends over a space equal to 24 of these subdivisions, and this is divided into 25 equal parts. Now, 24 divisions on the fixed scale are equal to $0.600''$, and this divided by 25 makes each division on the vernier equal to $0.600''$

or $0.024''$. Thus, the difference between

each of the two kinds of division is $0.001''$. If the measurement recorded is exact to the nearest fortieth, the zero scratch on the vernier will be in line with the fixed scale graduation concerned. Each of the successive vernier graduations will be $0.001''$ behind the graduations on the fixed scale, until by the end of this scale the graduations on both scales again agree.

Now, if the measurement is not exact to a fortieth, the vernier graduations will record the number of thousandths by which the vernier zero has moved past the last exact fortieth. All that will be required is to look along the vernier scale until a line on it meets a line on the fixed scale exactly. The number of the lines reckoned along from the zero will represent the number of extra thousandths beyond the clear fortieth, and when these are counted up the final measurement is in four parts.

This is best understood by reference to an example, here illustrated, or rather two examples. The first one deals with the simpler condition



The vernier caliper.

first mentioned, where the measurement is to an exact fortieth, so reckoning the figures engraved upon the fixed scale we get $1''$, then, as the last whole tenth was marked 4, we have to add $0.400''$, and on beyond that we count three-fortieths, equal to $0.075''$. The total of all these makes $1.475''$.

(Continued on page 118)

Model Engineers and National Service

*Capstan and turret lathes

By Edgar T. Westbury

Cutting Screws by Generating Methods

SCREW threads may be generated on capstan and turret lathes by several methods, including the use of a lead-screw, gear-driven from the lathe mandrel, much the same as in engine lathes. It is not, however, usual to employ an elaborate system of change gearing to enable a wide range of different threads to be cut with a standard lead-screw; the tendency nowadays is to use interchangeable lead-screws, each of which, in conjunction with a quick-change gearbox, will deal with threads of the same pitch, or simple multiples thereof, as itself. Thus, for instance, a "leader" of 4 t.p.i. will cut threads of 4, 8 and 16 t.p.i.; a 6 t.p.i. "leader" will cut threads of 6, 12 and 24 t.p.i.; and so on. It is, of course, necessary to change the lead-screw nut when the leader is changed, but this is facilitated by using, instead of the usual split or half-nut, a rotatable member having segmental faces cut to correspond with internal threads of different pitches. This "nut," which is similar to that shown inset in Fig. 10, is turned into position to suit the leader in use at the time.

One of the advantages of the interchangeable "leader" system is that it eliminates the possibility of error in picking up threads, and it also distributes the wear which would normally be encountered in a single lead-screw and nut, over the range of interchangeable parts. To further simplify the operation of screwcutting, the mechanism for engaging the nut with the screw may be interconnected with a quick-return motion on the cross-slide, so that as the screw is disengaged, the tool is simultaneously withdrawn from the cut; and this may be effected automatically as the saddle approaches a limit stop. The risks of over-running the end of the thread, or otherwise spoiling the work by faulty manipulation, are thus almost entirely removed, and many operations which would be almost impossible by ordinary methods (such as, for instance, cutting an internal thread on the "wrong end" of a bush, behind a shoulder), may be carried out quite easily.

Another method of thread generation which has

been very extensively used is by means of a chasing device, positively fed by means of a short lead-screw attached directly to the tail end of the lathe mandrel. This method is practically a survival of the old "hob and drag" method used many years ago by brass-finishers. The usual equipment fitted to lathes for this purpose consists, as shown in Fig. 10, of a rigid shaft fitted with two radial arms, one of which carries the segmental nut, and the other the chaser or screwcutting tool. This shaft is mounted in bearings at the back of the lathe bed, so as to be free to turn, and also to slide longitudinally. When the chaser arm is swung down so as to engage the work, the nut is simultaneously engaged with the lead-screw at the end of the mandrel, and, by this means, the entire shaft is propelled endwise, so as to cut a thread of the same pitch as that of the lead-screw. The latter must, of course, be changed, together with its follower nut, for screws of different pitches. In modern lathes fitted with this form of screwcutting gear, provision is usually made for adjusting and limiting the depth of the cut, also,

in some cases, for disengaging the tool at the end of the thread. Although this method of screwcutting is obviously impracticable in hollow mandrel bar-feed lathes, a modification of the idea, employing a gear-driven hob, is occasionally used.

Yet another

form of screwcutting gear is sometimes encountered, in the nature of an attachment for lathes which are not fitted with a lead-screw. It embodies a special tool holder, generally carried on the turret head, incorporating its own lead-screw, which is driven by an articulated overhead shaft geared to the lathe headstock. A clutch, usually provided with some method of automatic disengagement, is fitted to the tool holder.

Screwcutting Tools

Single-point tools have obvious disadvantages for rapid production work, as the edge of the tool may be excessively loaded and either become rapidly blunted or break off. In any case, it is

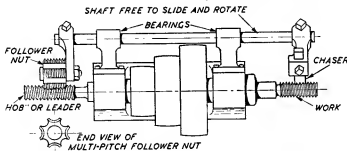
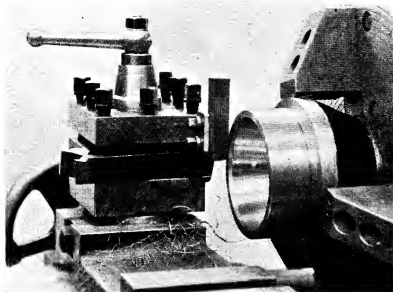


Fig. 10. Diagram illustrating principle of operation of chasing gear, as seen from above lathe headstock.

Continued from page 66, "M.E." January 18, 1940.



Tangential chaser, set in inverted position with lathe running in reverse. (Messrs. Alfred Herbert Ltd.)

extremely difficult to form the top of the thread properly with a single-point tool, unless it is followed up by a chasing operation. It is, therefore, usually considered desirable to cut the thread entirely by means of a machine chaser. The latter may be of somewhat similar shape to a hand chaser, but of more robust proportions; that is, having a square or rectangular shank, with teeth of the appropriate pitch and angle cut on the front end. Better results are, however, obtainable by using machine chasers of the tangential type, such as that shown in the accompanying photograph. The example shown is used in an inverted position, and the lathe run backwards. In some cases, the chaser is equipped with a vertical feeding motion, so that as the depth of cut increases, the angle of rake becomes greater and the clearance less. (This principle is not uncommonly employed with various kinds of forming cutters, as will be seen later.) Circular form chasers are very popular for internal screw-cutting; these tools resemble a short plug tap, but have only one "flute," or notch, which is ground away to form the cutting edge.

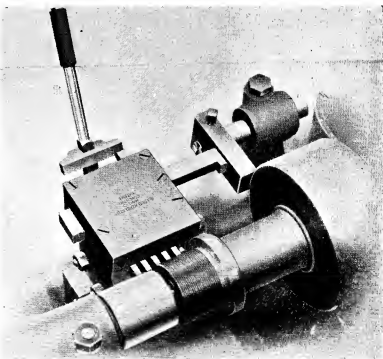
A very ingenious form of multi-point chaser head, which allows of the utmost speed of operation, is shown in the next photograph. It carries a number of narrow chasers, each one of which is set to cut slightly deeper than the one before it, so that the full depth is cut by

the time the last chaser has done its work. A sliding stop-bar is incorporated in the head, and engages an adjustable limit stop attached to the lathe headstock. The chasers are spring-loaded, so as to retract automatically as they are released, one by one, on reaching the limit of their cut. A lever is provided for re-setting the entire battery of chasers, ready for the commencement of a new cut.

For specially heavy screwcutting, capstan and turret lathes are sometimes equipped with thread milling attachments, which form the thread to full depth at one cut by means of a serrated milling cutter. The milling spindle is driven by a special arrangement of gearing, or by a separate motor incorporated in the tool fixture.

Forming

Although simple and comparatively light forming operations are often carried out by means of tools applied endwise from the capstan head (when the nature of the work permits), the majority of such work is done by tools mounted on the cross-slide; the reason for this being that the broad cut taken by a forming tool imposes exceptionally heavy strains on the tool and its



Multiple chasing tool with automatically retracting chasers, individually controlled by stop bar. (Messrs. Alfred Herbert Ltd.)

holder, and in most cases it is hardly practicable to use any form of steady. It is, therefore, obvious that the cross-slide tool-post affords a more rigid support for the tool than a capstan head tool-holder, and is generally to be preferred.

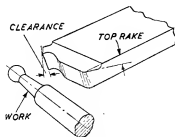


Fig. 11. Simple forming tool.

The forming tools themselves may be made from flat or rectangular tool-steel bar, having the front edge filed or ground to the required form, as copied from a drawing or template, and backed away to the appropriate clearance angle. Top or side rake may be ground as for ordinary tools, and they are mounted by the shank in the ordinary

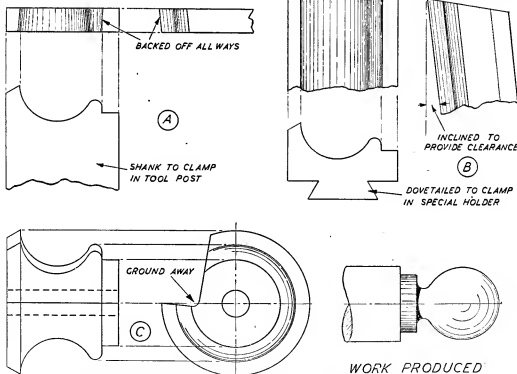


Fig. 12. Various types of forming tools. A, flat, B, tangential, and C, circular, for producing the spherical knob handle illustrated.

way, either in the front tool-post, or in an inverted position, in the rear tool-post (Fig. 11).

This type of tool, however, is only suitable for comparatively small quantity production, as it does not stand re-grinding many times, owing to

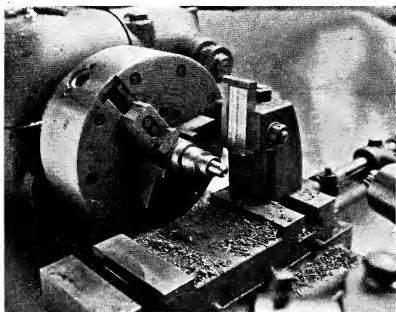
the lowering and also the weakening of the edge. For large quantities, a tangential type of forming tool, such as shown in the photograph, is definitely better; not only does it allow of many more re-grinds and re-settings, but the production of the tool profile in continuous lengths allows of making several tools at once, so that a number of lathes can be set up to produce identical forms. It is, however, a more difficult type of tool to produce at short notice (see also Fig. 12b).

This disadvantage can be eliminated, while retaining the advantage of a continuous profile cutting edge, by using a circular form tool, as shown in Fig. 12c. Tools of this type can be made by turning from circular tool-steel bar, to any complicated profile, and are mounted on a bolt which passes through a plain bar or a forked shank. The latter is preferable, because it provides a friction grip on both sides of the tool, and thus more effectively resists the tendency for it to turn away from the cut. Re-grinding of such tools is usually carried out in the same way as for milling cutters, and nearly all the circumference may be ground away before the cutter is worn out. The only disadvantage of the circular form cutter is its liability to turn, though, in some cases, this

may be actually an asset, as it constitutes a "safety valve" against overloading the cutting edge; but this is only so if the operator is sufficiently intelligent to keep a careful check on the work turned out, and not to carry on producing

scrapped parts with a cutter that has become displaced.

Form cutters should not be called upon to do unnecessary work, and, for this reason, components which have to be formed should be first turned down to such a size that the form cutter will only just have to cut to the full depth of its profile. If this rule is observed, any displacement of the cutter can be instantly detected by the incomplete pro-



An inverted tangential form tool in use. Note that the tool is held in a special tool post and inclined at a slight angle to provide front clearance. (Messrs. Alfred Herbert Ltd.)

file which it produces.

The breadth of the cut which may be safely taken with a single form tool is to a great extent limited by the rigidity of the lathe and also the work itself. For extremely broad profiles, especially in cases where the work cannot be adequately supported, it is better to use profile generating tools, than simple form tools of the type here described.

(To be continued)

Gauges and Gauging

(Continued from page 114)

The second example shows the same conditions, but no exact agreement of the vernier zero line and the third graduation as before. Instead, the zero line has passed a little way along, so, counting up along the vernier scale, we find that the 11th graduation agrees with a line on the fixed scale; this means that $0.011''$ (eleven thousandths) must be added. Now our total is in four parts— $1'' + 0.400'' + 0.075'' + 0.011'' = 1.486''$.

And that is all there is about reading a vernier scale to thousandths of an inch. This is the usual limit for a caliper square, any greater accuracy is hardly to be expected from a sliding contact of jaws; we shall meet the screw caliper presently, and that provides the maximum degree possible by any ordinary method.

The sliding jaw type of caliper is also made in the form of a height gauge; mounted on a stout base, there is a vertical column carrying the graduated scale, over which the sliding jaw moves. This jaw probably carries also a scriber point. In a similar way to the caliper square, a screw is provided for fine adjustment of the moving jaw, this latter being brought approximately up to the work, the fine adjustment screw block is clamped to the vertical column with a set-screw, and the final setting of the moving jaw made by the adjusting screw.

We have omitted, so far, any mention of the graduations on measuring instruments for metric measurements. The usual is an approximate equivalent to $1/1000''$, 50ths of a millimetre. Actually, this fraction is the $1,270$ th part of an inch.

Depth gauges are also made in this form, and with these the base carrying the vernier is fixed, and the blade carrying the scale is made to slide up and down. Depth gauging is not as easy a job as might be thought, especially when using a fine adjustment screw. We have some special notes on this subject, also to come later on.

The caliper square can be used quite legitimately as a limit gauge for a few parts that do not justify the making of snap gauges. By using the two locking set-screws alternately the two limits can be applied quite easily. If, for instance, the sizes are to be $1.000''$ and $1.003''$, the jaws are first set to the larger size, and the locking set-screw of the adjusting block tightened up. This gives the "go" part of the gauge. To get the "not go" part, the adjusting screw is used to close up the jaws by 3 thousandths, a perfectly easy matter to the man who has learned how to use his vernier gauge backwards as well as the normal way. Our instructions should make the method clear.

(To be continued)

The Beginner's Guide to Lap and Lead

By "L.B.S.C."

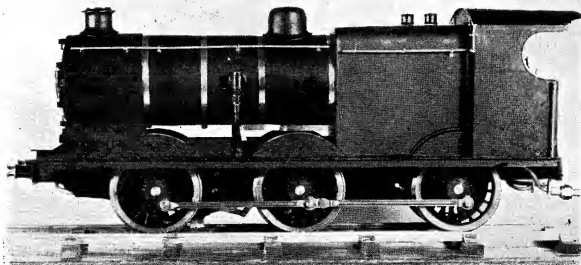
DURING the past few days (time of writing), I have received from various followers of these notes, both beginners and experienced workers, letters and telephone messages, the gist of which is "For goodness sake, old man, give us a plain and simple explanation of the rock-bottom truth of this lap and lead business, in language that any beginner can understand first time." Well, your humble servant is always willing to do his best, so here goes for a lobby chat on the subject. In the old days, lap and lead, and its effects on the working of a locomotive, were never-failing sources of debate in enginemens' lobbies; and many an old driver has given to his younger confreres the explanation I am going to give you now, to their great satisfaction and understanding. It is addressed, be it noted, only to those who are professedly ignorant of the subject, and are genuinely seeking information; also to any others who have an unprejudiced and unbiased mind open to assimilate actual facts.

How Lap and Lead First Came About

The slide-valves, or D-slides as they were often called, on the old stationary steam engines, were made just to span the distance between the outer edges of the steam ports, whilst the exhaust cavity spanned their inner edges. Consequently, steam was admitted the full stroke of the piston; and simultaneously with the closing of the steam port, when the crank arrived at dead centre, the

eccentric being set exactly at 90° in advance of the crank, the exhaust port opened, and remained open until the piston reached the other dead centre. This arrangement worked fine on the stationary engines of that period, because of their slow speed; according to an old book I have here, about 60 revolutions per minute was considered quite fast. Personally, I should imagine it was plenty fast enough for the ancient samples preserved in the Science Museum at South Kensington!

When the locomotive came on the scene, stationary practice was naturally applied to it, as nothing better was known; and on the five-miles-per-hour colliery locomotives, it answered pretty well. But when passenger engines eventuated, and wheels began to turn a bit faster, it became obvious that the engines were choking themselves by trying to pass too much steam through the cylinders. The full story is far too long for these notes; any earnest student of locomotive development can look it up for himself, as there are many books of reference which can be consulted. Suffice it to say that it was found, by lengthening the valve, and advancing the eccentric so that the ports opened and closed early, great economy of steam was obtained, and the corresponding earlier exhaust relieved the back pressure on the piston, thus admitting of a much higher rate of speed.

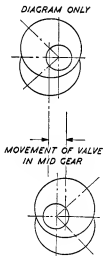


A North-countryman's first attempt at an L.M.S. "4F."

What Actually Happens

As I have remarked before, everything in this benighted world takes *time*; opposite extremes being a flash of lightning and Uncle Adolf's blitzkrieg. Therefore, it takes a certain amount of time for steam to enter a cylinder and build up to its full pressure against the piston head. Now it should be obvious, even to the Duffer-in-Chief of the Most Worshipful Association of Woodenheads, that if steam is not admitted to a cylinder until *after* the piston has passed dead centre, the pressure will not build up and take full effect *until the piston has already completed part of its stroke*. As the speed increases, and the piston "runs away from the steam," the full-pressure point becomes later and later, until a balance point is reached at which the steam cannot enter the cylinder quickly enough to increase the speed any more. The size of the port, and the amount it is opened by the valve, also have an important bearing on the matter.

Recognition of the above simple fact makes it obvious that, in order to obtain the greatest power, full pressure of steam should be built up on the piston head *at the instant the crank passes dead centre*, so that the connecting-rod can give the crankpin the mightiest of thrusts, as soon as the crankpin comes off centre and can receive it. The intelligent tyros who are reading this, will immediately say, "Well, why the merry dickens cannot the port be opened a little sooner, so as to admit steam in plenty of time to build up to full pressure as the crank passes dead centre?" *That is exactly what is done*; the distance the port opens before dead centre is called "pre-admission," and the amount of port opening on dead centre is called "lead."



Why valves operate with lever in middle

The Truth About So-Called "Negative Lead"

A great deal of sense and nonsense has been written and spoken about so-called "negative lead." A good example of the former was our worthy Knight of the Blue Pencil's contribution in a recent editorial, only he did not go quite far enough, so I will endeavour to pull his train right up to the buffer-stops. In the first place, the term is ambiguous, if not ridiculous; I have never heard the words used by an engineer, they call it "valve lag" (opposite to valve lead), so I will call it the same, as I have always done. I do not take my dog Mick for his midnight ramble around streets illuminated by negative lights!

No full-size locomotive engineer has, or would,

deliberately design an engine with a valve lag in full gear; if and when such has happened, it has been unintentional, and this is how it comes about. There are, as most followers of these notes know, two ways of coupling up the eccentrics to the links of a Stephenson link-motion. One is at the top and bottom, directly above and below the die-block slot; the other is behind the slot. In the former case, the die-blocks, and consequently the valve, has less travel than the eccentrics, as it is nearer what you might call the centre of oscillation. In the latter case, the die-blocks line up with the eccentric-rods in full gear, but the little ends of the rods are brought much closer together, which means a bigger angularity of the link when the eccentrics are at the limits of their travel. This travel is very considerable with a modern locomotive having big ports and long-travel piston-valves; and the latter introduces another factor, viz., the eccentric has to have an inordinately greater angle of advance, in order to bring the valve setting correct. Yet another factor is a sharp-radius link, due to short eccentric-rods between coupled axles.

Now here we have a combination of circumstances which give the link an excessive "bodily swing" when the valve-gear is in mid-position, see diagram. It is well known that a Stephenson link motion gives an automatic increase of lead as the die blocks approach the middle of the links; and the more pronounced the before-mentioned factors are, the greater this amount of lead becomes. It is also well known that you can have too much of a good thing, as the relatives of the patient found out when he took the whole bottle of medicine at one dose, and they had to send for the undertaker instead of the doctor. We have seen above, that a certain amount of lead is necessary to allow the steam to reach full pressure on the piston head as the crank passes its dead centre; but, for the most economical running, this should take effect at the average speed of the engine, and the exact amount depends on the size of the ports and cylinders, and the steam pressure. The locomotive engineer who knows his job, can easily calculate how much lead to give his valves by comparative tests with other engines; and these tests will also indicate the usual point of cut-off for the required speed. Therefore—and this is the crux of the whole matter—he *arranges the desired amount of lead at that particular point of cut-off*; and the lead in the other positions of the gear is left, in a manner of speaking, to look after itself.

Naturally, if a Stephenson link-motion *increases* its lead when approaching mid-gear, it *decreases* as the die-blocks approach the ends of the links. Therefore, it is quite plain for everybody to see that, in the case of a gear having short links, long travel and a big angle of advance, the difference in lead movement between the full-gear and mid-gear positions, would be quite sufficient to change a small lead in the notched-up or running position into a lag when in full-gear position; and that is

exactly the state of affairs on the engine which has been built for Mr. Maxwell, and which brought the controversy to a head. I have not seen the engine, and probably never shall; but it does not need a loco. "Sherlock" to deduce the facts.

Comments and Facts

The designer of the engine is a highly valued friend, and different folk having different ideas, I would not wish to criticise his design for one moment; but if I built a similar engine there would certainly be no valve lag present, and the slow starting in full-gear, mentioned in the K.B.P.'s editorial, would be conspicuous by its absence, whilst the acceleration, speed and sustained tractive effort would all be present and correct. A plain statement of fact is no idle boast. As followers of the old "Live Steam" notes know full well, I have spent hours and hours on valve-gear experimenting, with locomotives on the road under all kinds of service conditions; and, by this time, I know how much lead is required, and how to apply it. Experience is still the best teacher!

Some years ago, I built a $2\frac{1}{2}$ " gauge "Pacific," something like "Fayette," but with $\frac{3}{8}$ " piston-valves, Stephenson link-motion similar to the Great Western pattern, steam ports nearly $5/32$ " wide (equal to flat ports $1\frac{1}{2}$ " by $5/32$ "!), and eccentrics with bosses and set-screws which could be readily adjusted in a few seconds. A huge number of different settings were tried. Suffice it to say that with a lag in full-gear, she was—well, three letters!—despite the fact that it changed to a small lead as soon as notched up. The final setting gave a good lead in full-gear; and with the lever in the middle, the bodily swing of the links gave a cut-off of approximately 18%, with, of course, a correspondingly early admission, in either direction. Hauling a normal load of three passengers, this engine gets away and accelerates like one of Miss Milly Amp's outfits, the rate of acceleration being sustained as you pull the lever back gradually, until the coupling-rods "disappear." The "bottle-cork" exhaust crack in full-gear dies away to a steady purr, and she will blow off with the firehole door open. It would be impossible for the engine to maintain her speed with the load, without the very early admission. I have run this locomotive with Messrs. Meers and Rummens on the cars, also with Mr. Arvid Ohlin and his works engineer, and several other well-known personages, who would gladly confirm the above. She has also been handled by one of the principal locomotive "heads" of the Southern Railway, who was astonished at her speed and power, and nearly burned up the brake shoes on the car trying to hold her down and make her puff when running in mid-gear, with only himself as load.

After obtaining the most satisfactory setting, I checked her off in the same way as a full-sized engine, to find out the opening and closing positions of the valves; and though I had some idea of what to expect, nevertheless got a mild

surprise. However, when I removed the covers and took a look at the valves, frankly I was surprised a little more. As stated a little while ago, I am now weary of giving away the results of my experimenting, so suffice it to say that it was *not* anything like the setting of Mr. Maxwell's engine, but it bore a strong resemblance—a little exaggerated, owing to the higher r.p.m. of the small engine—to the true and unpublished settings of certain crack British and Continental locomotives, which I had obtained at various times, in strict confidence, in order to check with my own experiments.

The "Kick-Back" Fallacy Explained

There is one more point to clear up for tyros' and novices' benefit. We have seen that to build up full pressure on the piston-head at the instant the crank is on dead centre, the port must be opened *before* the crank reaches dead centre, to the amount of the lead. Even those of experience sometimes raise the objection that if the engine stops with the crank just before dead centre, and the valve is open to lead, the engine will try to "kick back" as soon as the regulator is opened. In 89 cases out of 100, it will do nothing of the kind. Reason? Simple, my dear Watson, as Sherlock Holmes would say. When one crank is at or near dead centre, with the port just cracked, the other is in absolutely the best position to receive driving thrust, that is, at half stroke; *and the corresponding steam port is wide open*. When the regulator is opened, the obvious will happen; long before steam has squeezed through the lead opening and built up pressure against the piston on that side, it has rushed through the gaping mouth of the other side, reached full pressure, and started the crank moving. Even if the pressure could build up on both pistons simultaneously, the engine still would start readily without kicking because the leverage on the crank at half stroke is far and away greater than that on the crank at or near dead centre, and so would easily overcome it. I have never had the experience of a small engine "sticking on the quarters." It sometimes happens with a big engine when starting a heavy load on a sharp curve, or on a bank; and, in that case, all you have to do is shut the regulator, open the cylinder cocks on the dead centre side, and give her steam again. This releases any unwanted pressure, and fresh steam entering the lead opening will blow away through the cocks before it can build up and offer any resistance to the thrust of the piston on the other side. The alternative is to reverse, and back a few inches or so, sufficient to close the lead opening when the lever is put into fore gear again. Many tyros have wondered how it is that an engine will start backwards when she will not start forwards, and now they will be enlightened.

The lap-and-lead movement of Walschaerts, Baker, Joy, or any similar radial gear being

(Continued on page 124)

An Experimental Synchronous Converter

A machine for supplying direct current for model working or other purposes

By R. Yorke, Grad.I.E.E.

THE main reason for building this machine was to obtain a supply of direct current, one alternative being to make a motor generator set. This would not be satisfactory, as the d.c. power output would be limited by the size of the generator itself, whereas in the case of the machine here described current at any pressure up to 400 volts can be rectified at any frequency up

that both castings were taken from the same pattern. They were made circular and cut away as shown.

The slip-ring end shield was bushed and fitted with diametrically opposite brushes for the rings in the outer end, whilst a disc of ebonite was fitted inside the larger diameter carrying the brushes in contact with commutator, *A*. This was constructed so as move these brushes as required, being controlled by the handwheel, as shown. The other end shield received a pair of brushes making contact with the rings of the rectifying commutator, as indicated in Fig. 4. A movable brush arm was spigoted on to the inside of the end shield carrying the d.c. brushes, which take off the rectified current from the centre track of



Fig. 1.

to 100 cycles per second. Mercury arc, metal and valve rectifiers were out of the question, due to constructional difficulties.

Construction

Work was started on the rotor by assembling the laminations on the shaft and tightening up by two flanges and a nut in the usual manner. The armature winding was then put on, consisting of 25 double-wound coils lap connected to the 50-section commutator, *A* (Fig. 2). A pair of slip-rings, *B*, were then added and connected to opposite commutator segments, as shown in Fig. 1. The ball-race and plate, *C*, were next fitted, and the rectifying commutator, *D*, then followed, as shown in Fig. 2. This completed the rotor.

The stator was next to receive attention, and follows orthodox rules in its design and construction, being fitted with a simple two-pole winding only, the ends being brought out to side terminals, as shown in Fig. 3. As patterns had to be made for the end shield casting, their design received much consideration, and it was finally arranged so

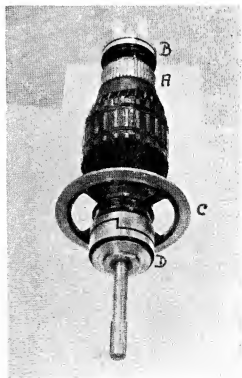


Fig. 2.

the commutator, being locked in position by suitable studs.

It was found, on test, that if the machine was accidentally run up to very high speeds, the rotor shaft began to whip. To prevent this, a

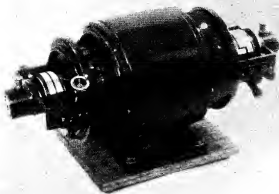


Fig. 3.



Fig. 4.

expanding bracelet was fitted inside the commutator, *A*, which may be seen in Fig. 1, underneath the slip-ring to commutator connection. When this expands, due to centrifugal force, then the whole of the segments of commutator, *A*, are shorted together, the machine then running virtually as a squirrel-cage induction motor, its speed being limited by the supply frequency. No method of cooling is employed, since the only power consumed by the machine is used to supply electrical losses and energy used in friction of bearings and brushes and windage of the revolving rotor. A general assembly view is given in Fig. 5, showing the machine mounted on oak baseboard and rubber feet, which make it practically soundless.

Control

To control this machine, the switchboard shown in Fig. 6 was constructed. The leads at the top are for connection to it. The meters indicate supply volts, stator and rotor currents. The main d.c. terminals may be seen at the bottom of the board below the controlling switches and the lamp in the centre, the purpose of which will be described later, the whole being protected by surface mounted fuses below the meters. At the rear of the board are housed the resistances controlling the machine.

Operation

The "modus operandi" is briefly as follows. Alternating current is switched on to the stator

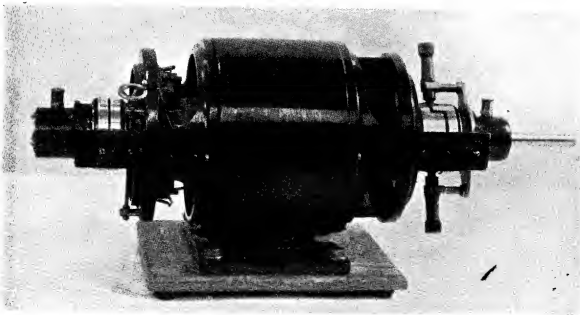


Fig. 5.

and as the brushes on commutator, *A*, are shorted together the machine runs up as a repulsion motor, the speed being controlled by the position of these brushes. The rectifying commutator, *D*, is then supplied with alternating current by means of the

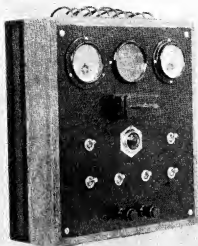


Fig. 6.

fixed brushes, the lamp shown on the switchboard being in series with this feed in order to limit the current, since a short circuit would occur if the d.c. brushes on the rectifying commutator passed over the gap in the centre track at any other instant than when the supply voltage was zero. If the machine is not synchronised with the supply, then a neon lamp, connected on the d.c. side, will flow alternately at one and then at the other of its electrodes. If this is the case, then the speed is adjusted so that the lamp glows steadily at one electrode only. This shows that the machine is synchronised and the commutator, *D*, is rectifying correctly; consequently, the lamp

in series with it can be shorted out, giving full voltage on the d.c. side.

As the machine is now running, its speed is not fixed, and may be altered by any variation in supply voltage which would pull the rotor out of step with the frequency, and so prevent it delivering direct current. Consequently, the machine is converted into a synchronous motor by switching the d.c. from the rectifying commutator into the armature by means of the slip-rings, *B*. This produces a fixed north and south pole on opposite sides of the rotor, and the machine will continue to run in step with the frequency, despite any change in supply voltage. D.C. for external use may then be taken from the terminals at the bottom of the switchboard.

Uses

The machine will be found useful for supplying direct current for electric trains, battery charging, electro-plating, magnetic chucks and practically any other purpose for which uni-directional current may be required.

It was found, during experiments, that this machine will run as any kind of d.c. motor or generator, except compound wound, and also as any a.c. single-phase motor or generator, except split-phase.

In such an article as this, it is impossible to describe the set-backs, the mistakes, and the number of times certain components had to be made before they worked satisfactorily; as well as the other petty annoyances which occur in model engineering of any kind. Without these experiences, the job would be finished far too easily, and consequently one would not value the finished article as highly as if these snags did not crop up. However, if any reader is sufficiently interested to make any queries about this machine, I will be only too pleased to answer them.

I would just like to add my acknowledgements to Mr. A. H. Avery, of THE MODEL ENGINEER Service Department, for supplying the complete winding specification for this machine. This was in 1935, so I hope that this article will recall it to mind.

The Beginner's Guide to Lap and Lead

(Continued from page 121)

operated by a separate lever unconnected with the actual reversing component, any lead given to the valve is constant, and does not vary with the position of the lever, as in the link motion. Therefore, the designer of a locomotive with a gear of this description, must decide on how much lead to give his valves for a combination of power, speed and economy of steam, and arrange matters accordingly. This is why I tell you in the "words and music," to put the die-block in the middle of the link—in other words, putting the reversing part of the motion temporarily out of action—and adjusting the valve until it shows a crack of port

at each end of its travel, when operated by the lap-and-lead lever alone. This gives a good "all-round" setting, which is evidenced by the performance of hundreds of "Live Steam" locomotives which have been built to my instructions, as told to me in correspondence by their delighted owners. If they had disregarded the notes, and set their valves to lag instead of lead, there would have been, instead, some heart-rending tales of disappointment and despair; enough said.

Constructional details again next week, all being well.

Practical Letters

Engines

DEAR SIR,—It may interest "B.C.J." to learn that about 1908 (and for how many years before and after I do not know), the organ in the wonderful old parish church at Bakewell, Derbyshire, was powered by a water engine similar to the one described by him on page 3, vol. 82.

My employer of that period caused it to be overhauled, his son was the engineer and I was the labourer, who wiped the spanners and leaned on the spade to prevent the handle falling in the dirt. My memory serves me well regarding this engine. A few approximate measurements from memory are:—Concrete base, 33" x 33" x 9"; four holding-down bolts, sunk in; two oval-section pillars to carry motion, foot of each pillar formed a shallow plinth; partitioned trunnion seemed to be cast with pillars; three cylinders, 15" x 4" O.S.; stroke, 8"; packed pistons and glands; ports, 2½" x ½" (rect.); trunnion about 4" dia., except where seatings were turned for semi-circular ends of cylinders; cylinders did not encircle trunnion, but were kept in tension on valve faces by a sort of compensated short bar which (one to each cylinder) rode on a fulcrum on the under side of the trunnion; flywheel, 24" dia. x 4" rim; length, 27"; breadth, less flywheel, 15"; height overall, 38". With the exception of the flywheel it was nearly all brass.

Power—a strong man, by taking a good hold of the flywheel could hold it steady with water full cock.

The port end of each cylinder had two one-hole lugs to bolt to tension bar.

Yours truly,

Burnley.

GEO. H. NEWTON.

DEAR SIR,—The article in the January 4th issue by "B.C.J." on "Engines—Some Early Memories," leads me to suggest that the modelling of old-timers would give just as much interest, and also, from an educational point of view, be of greater value than comparatively modern or present day types.

In particular, the one loco. definitely conspicuous by its absence in the railway centenary celebrations was the Metropolitan. This would surely afford as much interest to loco. enthusiasts, both in building and running, and eventually as museum specimens, as the better known types. One of feature of these, if I remember right, was the amount of polished copper on them, in particular the outside exhaust pipes leading to the chimney stack.

While I am writing, might I suggest that a practical article on electric radiators and other electric heating apparatus would be welcome. The smallest electric fire available, the bowl type, appears to be one of 600 watt consumption, which, in some cases, I have found to be far too big, and one of 250 or 300 watts would appear ample. The chief difficulty, to my mind, in the construction of one would be the refractory porcelainous core, and I suggest that this might possibly be made from a mixture of asbestos and Purimachos fire clay;

possibly some of your readers could make suggestions on this point, also on details of suitable wire.

Yours faithfully,

Grimesby.

M. ODLING.

Model Locomotive Novelty

DEAR SIR,—I have read with interest your "Smoke Ring" in the January 11th issue of THE MODEL ENGINEER, concerning "A Model Locomotive Novelty." I would like to suggest that the petrol engine, if possible, be a two-cylinder vertical, on similar lines to a car engine. I should think that this type of engine would suit the locomotive, and also offer a wide field in the construction of model agricultural tractors, transports, and other kinds of machinery, driven by a car-type engine.

I wonder if any other readers share these ideas, or is it a lone reader asking for something which is not a commercial proposition? Perhaps other readers would give their views on the subject.

I wish Mr. E. T. Westbury and Mr. J. N. Maskelyne every success in their novel venture.

Yours faithfully,

Lichfield.

K. H. JOHNSON.

DEAR SIR,—With reference to suggested design for a petrol-driven loco. in 3½" gauge, by Mr. Westbury and Co., I have been waiting for years for this and shall indeed welcome any design from so expert a source, but why only two cylinders? Speaking personally I would like to see this produced with a four-cylinder engine, the even running of such a motor would be ideal for loco. work, and if you could build a two you could build a four, and why not a fluid flywheel to provide the ideal "get-away"? It would appear to be the simplest form of transmission (we will leave the automatic self-change out of it!). My dream was to use two four-cylinder "Wall" petrol motors, one at each end, driving on to a common transmission, something with some power in it, with an overall length of about two feet; if it was not for the difficulty of getting castings and parts for the "Wall" motor I would have started long ago. "Vest pocket" motors have been almost done to death; let us have something worth starting on, something that will pull more than the driver and his dog when it is done! My apologies to the "Designing Lads" when they recover consciousness, but you asked for opinions!

Yours truly,

Royston.

L. C. RICHARDS.

[The engine that is being designed for the locomotive referred to is a two-cylinder 4-stroke, which is intended to develop about 1 h.p. This would seem to be, not only quite enough for a 3½" gauge locomotive, but eminently suitable for construction by the majority of enthusiasts, as well as avoiding the necessity for over-elaborate patterns for castings. Mr. Richards's suggestion to use two four-cylinder engines shows a tendency to overdo things; such power might prove very costly to the average constructor, and would not be really necessary unless the locomotive were required to climb trees or the side of a house!—Ed. "M.E."]

Model Locomotive Performance

DEAR SIR,—With reference to your comments on the letter by "Jos," published in your issue of January 4th, may I suggest that if the performances of engines of different scales are to be comparable, dynamical similarity is essential.

In the case of Mr. Clogg's "Cock o' the East," the statement that its speed worked out at 170 scale miles an hour merely meant that the engine could have covered 170 scale miles in one hour. That figure might be useful for comparing the performance of "Cock o' the East" with that of another engine of the same scale, but it can hardly bear any rela-

tion to the speed of engines constructed to other scales.

I do not suggest, of course, that the Henderson contest will not afford useful data. On the contrary, for engines of the same scale there can be no doubt that very useful information will be forthcoming. But I do suggest that if and when the performance of an engine constructed to one scale is compared with that of an engine constructed to a different scale, the principles of dynamic similarity must be taken into account if the comparison is to be of practical use.

Yours faithfully,
Winscombe.

S. W. BIDEN.

Reports of Meetings

The Society of Model and Experimental Engineers

The next Meeting of the Society will be held at 56, Old Bailey, London, E.C.4, on Saturday next, February 3rd at 2.30 p.m. The Society's boiler will be under steam and available for the running of models. Work exhibited will be eligible for the Silver Medal and Exhibit Competitions.

Visitors' Tickets, and full particulars of the Society, may be obtained on application to the Secretary, H. V. STEELE, 14, Ross Road, London, S.E.25.

The Junior Institution of Engineers

Friday, February 9th, 1940, at 39, Victoria Street, S.W.1, at 6.30 p.m., Ordinary Meeting; Paper, "The History and Development of Lubricated Plug Valves," by P. Meredith (member).

Mancunian Model Engineering Society

On January 19th, we enjoyed another continuation of Mr. J. Wood's lectures on "Pattern Making." On this evening he showed the members, in his usual interesting manner, how to set about making a pattern and core-boxes for a locomotive cylinder. This demonstration, and the usual discussion which followed, brought to a close a very happy and instructive meeting. At our next meeting, on February 2nd, we hope to have a steaming demonstration of a 1" scale traction engine by Mr. Melph.

Meetings held each Friday at 8 p.m., at Old Garrett Hotel, Princess Street, Manchester.
Hon. Secretary and Treasurer, H. STRUBBS, 23, Ashdene Road, Heaton Mersey, Manchester.

The Southampton and District Model Engineering Society

The Annual General Meeting was held on January 14th, at the Bevor's Castle Hotel, when it was decided to hold a monthly war-time meeting. This will be held on Sunday mornings in winter, and Saturday afternoons in summer time.

Admiral Sir Reginald Bacon, D.S.O., was again elected President, with Mr. H. Lainson as Chairman.

The committee has been temporarily reduced to four persons.

Hon. Secretary, S. W. ATKINSON, "Woodcroft," Merdon Avenue, Chancellors Ford.

Norwich and District Society of Model Engineers

There was a fair attendance of members at the General Meeting of the Society, held on Thursday, January 18th, 1940, to hear Mr. W. Cooper give his talk on "Model Petrol Engines." Mr. Cooper dealt mainly with the 2-stroke cycle engines, and described various designs to show the development which had taken place in this type of motor since 1881, when Mr. Dugal Clarke built the first 2-stroke engine. Several models were produced by Mr. Cooper, and he explained how he had built them, the theories on which the designs were based, and the performance obtained.

Mr. Cooper also displayed a blower, and several patterns and castings of parts of his engines, together with the miniature ball-bearing races, piston rings and sparking plugs used.

On the motion of Mr. H. O. Clark, a hearty vote of thanks was accorded Mr. W. Cooper by all present, for delivering such a theoretical yet practical account of model petrol engine building.

Next meeting, Thursday, February 1st, when a lantern lecture entitled "Repairs by Welding" will be given.

Secretary, F. W. LOVICK, 24, Wymer Street, Norwich.

NOTICES

The Editor invites correspondence and original contributions on all small power engineering and electrical subjects. Matter intended for publication should be clearly written on one side of the paper only, and should invariably bear the sender's name and address. (Unless remuneration is specially asked for, it will be assumed that the contribution is offered in the general interest. All MSS should be accompanied by a stamped envelope addressed for return in the event of rejection.)

Readers desiring to see the Editor personally can only do so by making an appointment in advance.

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All correspondence relating to advertisements to be addressed to THE ADVERTISEMENT MANAGER, "The Model Engineer," 60, Kingsway, W.C.2.